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SCIENTISTS ANALYZE POSSIBLE "COMET DUST"

Tiny particles of dust that may have been shed from a passing comet have been analyzed successfully by a group of university scientists working for NASA. Their results, reported in the current issue of Science magazine, suggest that this unique, little-understood extraterrestrial material may contain chemical information dating back to the formation of the solar system 4.5 billion years ago.

The successful analysis of single dust particles weighing only a billionth of a gram (about one 30-billionth of an ounce) was carried out by Dr. T.M. Esat, Dr. D.A. Papanastassiou and Prof. G.J. Wasserburg, all of the California Institute of Technology, and by Prof. Donald E. Brownlee of the University of Washington.

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They used special instruments, originally developed to analyze Moon rocks and meteorites, that could handle, dissolve and analyze the tiny particles without loss or contamination.

"This is a real breakthrough," said Dr. Bevan M. French, discipline scientist for NASA's Planetary Materials Program, which supported the research. "There's a tremendous amount of this extraterrestrial dust around. About half a ton of it falls to Earth every day, and much of it may have come out of comets or new kinds of fragile meteorites that don't survive to reach the ground. We could get an enormous amount of new information out of this dust -- but until now, we've never been able to collect these tiny particles free of contamination or to analyze them one at a time."

The dust particles were collected by aircraft flying high above the layer of terrestrial pollution, and they appear definitely extraterrestrial. Their chemical composition, measured with an electron microscope, is similar to that of known meteorites and not to terrestrial materials. More precise analyses of the elements magnesium and calcium, which were made in a special laboratory at the California Institute of Technology, suggest that small chemical anomalies are present in some of the particles.

If these anomalies show up in more particles, it will indicate that the dust still contains evidence of nuclear reactions that occurred when the solar system was formed.

The successful analysis of possible "comet dust" comes at a time when NASA is actively planning a major mission to send an unmanned spacecraft to meet Halley's Comet when that brilliant visitor makes its next regular appearance in late 1985. The spacecraft would observe Halley's as the comet flashes by and then would rendezvous with a lesser-known comet called Temple II.

But no samples can be returned from either comet by this mission, and the dust analyses are even more important for the near future.

"Pieces of comets are probably raining down on our heads all the time, but we've never been able to analyze them before," says Dr. French. "With luck, we could find out a little about what a comet is made of before we ever see one close up."

Brownlee and his associates collected the dust particles by attaching sticky plates to a NASA-operated U-2 aircraft.

Carried to an altitude of 20 kilometers (65,000 feet), well above the contaminating terrestrial particles produced by volcanic eruptions and human activities, the plates trapped only extraterrestrial dust particles that had entered the Earth's atmosphere and were drifting downward.

Three different kinds of particles, most of them about 1/100 of a millimeter (1/2,500 of an inch) across, were discovered when the plates were carefully cleaned at the University of Washington. The most common particles are fluffy, and each one is made up of as many as a million separate grains of different minerals. A second type is also fluffy, but is made up of many tiny crystals of a single mineral. The chemistry of these two groups, measured with a scanning electron microscope, is like that of chondrites, one type of meteorite that falls to Earth, but the fluffiness of the particles indicates that they were never a part of any dense meteorite. A rarer type of dust particle also was found -- tiny hard spheres formed by a melting event that took place either in the Earth's atmosphere or in outer space.

For more precise measurements of the elements magnesium and calcium, the samples were transferred to Esat and his associates in a special laboratory at the California Institute of Technology.

This group hoped to detect small anomalies in the magnesium and calcium of the dust particles. Similar anomalies have been detected in the Allende meteorite that fell in Mexico in 1969. They apparently are caused by unique nuclear reactions that took place at the very beginning of the solar system or even before -- possibly in a nearby supernova explosion that may have triggered the formation of our solar system.

Even for this experienced group, which pioneered the work on lunar samples, the analysis of a single dust particle demanded a new level of technical skill. All the work was done in clean rooms and under special hoods so that no terrestrial dust could contaminate the analysis. Each tiny particle was carefully moved with mechanical micro-manipulators until it could be inserted into a tiny drop of acid placed on a thin wire made of the high-temperature metal, rhenium. To make certain that the drop stuck to the wire, the scientists added a tiny bit of "orange juice" -- a synthetic mixture of citric acid and sugar -- to the drop. Then the wire was heated, the dust particle dissolved in the acid, the acid evaporated, and streams of atoms shot from the hot wire filament to be focused by a magnetic field and measured.

In most of the dust particles analyzed, the magnesium and calcium were "normal" -- that is, like that found in Earth rocks and most meteorites. In four particles, possible anomalies were observed in the magnesium. If these anomalies can be confirmed by analyzing more dust particles, it will show that some of this dust came from objects that go back to the beginning of the solar system -- most likely comets, which have spent most of their lives deep-frozen beyond the edge of the solar system since they were formed 4.5 billion years ago.

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